The University of Chicago

A STUDY OF CHINESE-AMERICAN CHILDREN

I. DIETARY STUDY

II. PHYSICAL MEASUREMENTS

A PART OF THE DISSERTATION SUBMITTED TO THE GRADUATE FACULTY IN CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF HOME ECONOMICS AND HOUSEHOLD ADMINISTRATION

By

JEAN ELIZABETH HAWKS

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A STUDY OF CHINESE AMERICAN CHILDREN

I. Dietary Study*

JEAN ELIZABETH HAWKS, M.S.**

It is not known whether the small size of Oriental peoples as compared with Occidentals is due to environment or to racial characteristics. If environment is the influential factor, the question arises as to whether changed conditions of living and alteration of diet might affect the metabolic processes and consequently the stature of children born to Orientals who have lived for some time in America. The present investigation is an attempt to throw some light on this problem by intensive individual studies on twenty-two Chinese children living in Chicago. It includes chemical analyses[1] of their diets for energy value, protein, calcium and phosphorus; determinations of their basal metabolism; and a report of their physical measurements. The results are compared with both Chinese and American values. This paper presents the dietary study. Other aspects will be reported in subsequent articles.

SURVEY OF LITERATURE

Although much has been written about Chinese diet and its probable adequacy, the quantitative studies in which data for children are included are relatively few in number. For the sake of economy in discussion, the important points concerning these are summarized in table 1. None

* From the Nelson Morris Institute for Medical Research, Michael Reese Hospital, Chicago, and from the Department of Home Economics, University of Chicago. Received for publication September 5, 1931.

** The data are taken from the dissertation submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the Department of Home Economics, University of Chicago.

[1] The writer wishes to acknowledge the technical assistance of Mildred Kaucher, B.S.

TABLE 1

Dietary studies reported from China

AUTHOR	DATE	LOCATION OF STUDY	TYPE OF INVENTORY STUDY	TYPE OF PEOPLE	LENGTH OF STUDY	SUBJECTS			UNIT OF MEASUREMENT	CALORIES		PROTEIN		CALCIUM	PHOSPHORUS
						Adult	Children								
						Number	Number	Age		Total	Cereals	Total	Animal		
					days						*per cent*	*grams*	*grams*	*grams*	*grams*
Van Buskirk	1921	Korea	Institution	Mission school pupils	30–90	58	528		Individual	2,727	89.0	90.9	5.2		
	1922	Korea	Institution	Working men	30–90	23			Adult male	2,366	79.0	89.0	16.0		
Adolph	1923	North China	Home	Middle class	21–70	147	76	1–12	Adult male	2,922	87.0	111.1	5.3		
	1925	North China	Home	Middle class	21–70	340	114	1–12	Adult male	2,471	87.0	77.9	4.7		
Hammond and Sheng	1925	Peking	Individual	Boys in home for poor	2		96	6.5	Theoretical	900		25.0	5.0		
								10.5	children	1,000		40.0	5.0		
								14.5		1,700		55.0	5.0		
Wu and Wu	1928	North China	Home	Middle class	7	146	47	1–18	Adult male	2,901	72.0	86.1	9.1	0.327	1.130
		North China	Home	Farmers	7	76	33	1–18	Adult male	3,139	83.3	94.3	7.7	0.382	1.552
		North China	Institution	College students	30	299			Adult male	3,044	77.8	95.5	25.0	0.325	1.110
		North China	Institution	Middle school pupils	7	150			Adult male	2,746	80.0	90.1	7.0	0.346	1.081
		North China	Home	Factory employees	30	138	104	1–18	Adult male	3,141	93.1	92.3	0.8	0.278	0.958
		North China	Home	Factory employees	7	84			Adult male	3,889	85.9	92.1	9.3	0.367	1.236
		North China	Institution	Restaurant patrons	38	Many			Adult male	3,000	91.6	94.4	4.3	0.228	0.913
				Average of all types		893	184	1–18	Adult male	2,977	82.0	91.7	9.7	0.337	1.178
Tao	1928	Peking	Home	Poor families	180	115	105	1–17	Adult male	2,595	92.7	75.9	1.3		
		Peking	Economic	School teachers	30	43	18	1–17	Adult male	2,742	80.4	84.3	6.4		

of these studies was made in South China, the section from which the parents of the children of this study came. All authors state, however, that the essential difference between diets in northern and southern China is that rice is the principal cereal used in the South, while wheat is used in the North.

With the exception of two studies made in Korea (37, 38), all investigations were conducted in or near Peking. There were two institutional studies, all the others having been made in the homes of people whose diets were representative of the poor or middle classes. Adolph's (1, 2) investigation was made with the aid of 30 students of Shantung Christian University, who weighed all food consumed in their own homes during one summer month. The report of Wu and Wu (49) includes studies of seven groups, a portion of the results having been previously published (23, 44, 45). The basis of Tao's (34) conclusions is a study of the expense accounts of families living in Peking.

From the standpoint of procedure none of the results can be considered entirely adequate. Most of the studies were made by the inventory method and children's intakes were evaluated in terms of an adult male unit. This unit varied greatly. In some cases a child was counted half of an adult up to 12 years and an adult thereafter, in other cases a sliding scale was used similar to that of Atwater (9). All studies give values for calories and protein, and Wu and Wu also report figures for calcium and phosphorus. Computations were made from American tables of average composition of foods, and were supplemented by data available from analyses of Chinese foods made by Levene and Cadbury (21), Sherman and Wong (32), Wu (47), and others (6, 7, 8, 15, 43).

The results reported in all these inventory studies are similar. Bulky carbohydrate diets furnished from 2366 to 3889 calories per adult male unit. Cereals provided from 72 to 93 per cent of these calories. Total protein varied from 75.9 to 111.1 grams, but the proportion of animal protein was exceedingly low, ranging, in the majority of reports, from 1.3 to 9.3 grams daily. Adolph (4) and others (16, 24, 36, 48) state that the degree to which the protein is utilized in the alimentary canal may be reduced by an excessive bulk of food to from 40 to 60 per cent of its original value. Thus they believe that these diets were suboptimal in protein. Calcium was low in the diets in which it was computed, averaging only 0.337 gram per day; phosphorus was about the same as that in an average American diet. The low calcium content might be accounted for by the absence of milk, as its use was noted in but few families.

Hammond and Shen (17) attempted the only individual study which has been reported on children and conducted it in a home for poor boys. These authors computed values for three theoretical children, 8, 12, and 16 years of age, by weighing the food consumed by a number of different children during two days. Since a Chinese child is considered one year old when he is born and another year is added to his age on the next lunar New Year, even if it occurs the day following his birth, Hammond and Sheng, in order to compare their data with American standards, reduced the given ages of these boys one and one half years. This procedure diminished the accuracy of the results, as did the fact that the investigators added 5 grams of fat and 5 grams of meat routinely to each diet, regardless of the age of the child. The figures for the intakes of these children are extremely low, not more than half of Holt's standards for either calories or protein.

The impression given by the foregoing studies, together with a number of general discussions (3, 4, 5, 13, 45, 46) on the subject of Chinese diets, is that the diet is not adequate for optimum growth and development. Since cereals furnished such a large proportion of the diets studied there is a question as to whether all the essentials could have been supplied. In fact, Wu and Wu (49) state: "The Chinese diet is adequate in energy, probably adequate in vitamins B and C, suboptimal in protein and vitamins A and D, and deficient in calcium."

This view, however, must not be accepted without discussing the other side of the question, since the Chinese race has existed on similar food for centuries. Computations of typical diets show that they may be adequate in the constituents considered essential in the Western world, although they are close to the lower margin in their calcium contents. According to Wang (40) the diet is not suboptimal in protein. Meat, fish, and the glandular organs of animals, as well as the blood, are commonly eaten; eggs are served every day; and soy beans, which contain considerable protein, are always included in Chinese diets. She also states that many minerals and vitamins are supplied by large amounts of green vegetables and melons of numerous varieties which are eaten daily.

It is probable, however, that the diets of different classes throughout China vary greatly since Milam (25) has shown in a study of economic conditions that well-to-do families spend proportionally more money for meat, fish, eggs, sweets and fruit, and less for cereals than poor families. It is also possible that dietary conditions are changing with economic conditions in China, and that the influence of Western civilization is

resulting in the use of highly milled products, such as polished rice and white flour, in place of the whole grain cereals. Wu (45) says that meat is so expensive today that it is served in smaller quantities with larger amounts of vegetables than formerly. Eggs, which have also increased in price, are less extensively used, and Tso (35) fears that their omission from the present day diet will cause a serious condition since they furnish the vitamin which produces an efficient utilization of the small amount of calcium. These changes have produced conditions described by Adolph (5) in his most recent article, in which he says that the poorer classes of Chinese constantly live on the verge of starvation. He bases his statement on famine studies which show that a slight lowering of quantity or quality of the food produces immediate disaster.

This literature shows that many more investigations on dietary conditions in China are needed before the results can be considered accurate enough for comparative standards.

EXPERIMENTAL PROCEDURE

Through a Chinese interpreter,[2] 22 Chinese children in 11 families living in Chicago were secured as subjects for the present investigation. With the exception of M., who was 17 years old, the 12 boys and 10 girls were between the ages of 5 and 14 years. Twelve lived in the crowded Chinese district, while the others, whose parents were of higher financial status, resided in neighborhoods where living conditions were better. All were of Cantonese parentage. Nineteen were natives of Chicago and were of the first generation born in America, while 3 were born in China. With the exception of the 4 children in the C. family, who were neglected and undernourished, the subjects appeared to be in good physical condition, although they were undersized for their ages according to American standards.

An individual dietary study was conducted in the home of each child during two consecutive days. The observer arrived each morning before breakfast and remained until bed time. It was believed that any psychological effects on the children which might have altered their food consumption had been reduced to a minimum. They were all well acquainted with the observer, who had visited their homes many times during the previous months for the purpose of taking them back and forth to the hospital for weighing and measuring, and for repeated metabolic tests which had been made previous to the dietary study.[3]

[2] Grateful acknowledgment is made to Miss Rose Lee for acting in this capacity.

[3] II. Physical Measurements will appear in the March, 1932, JOURNAL.

Through the interpreter, the mothers had been instructed to select and prepare food to which the children had been accustomed, and to avoid undue disturbance of the usual routine of home life.

All food was weighed as consumed, proper corrections being made for any that was left on the plate. When possible, dissimilar foods in mixtures, for example, meats and vegetables, were separated before weighing. A tested Chatillon balance was used and a sample of each food was immediately removed to a bottle and tightly corked. All food eaten between meals was also weighed. In the case of the undernourished girl, T. C., who was required by the school physician to eat lunch at school, the observer went to the school to weigh her food. The samples of food were dried at a temperature between 70 and 80°C., ground and thoroughly mixed. If a food contained a large proportion of fat, it was first quantitatively extracted with ether.

The caloric value was determined in an adiabatic bomb calorimeter designed by Benedict and Higgins (12). Weighed portions of the pulverized samples were made into pellets before burning. Nitrogen was determined by the usual Kjeldahl method and the factor 6.25 was used to convert it into protein. The quantity of dried material obtained from many of the semi-liquid foods was so small that micro-methods were used for estimating both calcium and phosphorus. The calcium was determined according to a modification of the Kramer and Tisdall (20) method for serum,[4] and the phosphorus according to the modification of the Bell and Doisy (11) method, as described by Wang, Kern and Kaucher (42).

RESULTS

Character of diets

Table 2 shows the frequency of occurrence of the principal foods, and the amounts eaten by the 22 children at 132 observed meals. As might be expected, polished rice occupied a prominent place in the diets.

[4] A sample containing from 1 to 5 mgm. of calcium was ashed in the presence of 5 drops of concentrated sulphuric acid. The residue was transferred with 15 cc. of 10 per cent hydrochloric acid to a 50 cc. conical centrifuge tube, and 1 cc. of 40 per cent sodium acetate, 2 cc. of saturated ammonium oxalate and 3 cc. of saturated oxalic acid were added. The acidity was adjusted with ammonium hydroxide to a pH between 4.8 and 5.4, using methyl red, suggested by Stohl (33), as the indicator. After standing over night, the mixture was centrifuged and the precipitate washed twice with dilute ammonium hydroxide (2 cc. of concentrated ammonia to 100 cc. of distilled water). Five cubic centimeters of 10 per cent sulphuric acid were added and the mixture titrated at a temperature between 60 and 80°C. with N/100 potassium permanganate.

It was never served for breakfast; but, except to 3 children, it was served at least 3 times, and to 12 children, 4 times or more, during the two days. Two children had none at all, but the average amount of cooked rice eaten daily by the other 20 children was 304 grams. Four children had over 500 grams. Other cereals were used to some extent. Cream of wheat, oatmeal, or corn flakes and white bread were served at some breakfasts. Hot muffins were eaten in one family and sandwiches in another.

TABLE 2

Weight of food eaten and times served per day

FOOD	WEIGHT OF FOOD SERVED				TIMES SERVED			
			Average serving				Average	
	Maximum	Minimum	Children served	All children	Maximum	Minimum	Children served	All children
	grams	*grams*	*grams*	*grams*				
Rice (cooked)	665	0	303.8	276.3	3.0	0.0	2.0	1.8
Other cereals	200	37	93.5	93.5	5.0	1.0	2.1	2.1
Vegetables*	263	47	132.9	132.9	4.0	1.0	2.1	2.1
Fruits	308	0	136.6	120.8	3.5	0.0	1.3	1.2
Milk	654	89	267.6	267.6	2.5	0.5	1.4	1.4
Butter	17	0	8.8	8.4	1.5	0.0	0.9	0.9
Eggs	97	0	48.7	35.4	1.5	0.0	1.0	0.6
Meat, fish and chicken	270	0	167.7	152.4	3.0	0.0	2.4	2.2
Soup	285	0	128.8	117.2	1.5	0.0	1.0	0.8
Sugar	24	0	8.6	7.0	2.0	0.0	0.7	0.6
Tea	179	0	111.5	20.7	2.0	0.0	0.8	0.1

* About 50 per cent were leafy vegetables.

All but 3 children had fresh fruit once a day or oftener, usually between meals. Every child had vegetables at least once a day, the average amount being 133 grams. The vegetables were seldom cooked or served alone, but were usually combined with fried meat, flavored with soy bean sauce, or oriental spices, and steamed about ten minutes. Since the time of cooking was short and little water was used in the procedure, the minerals and vitamins in the vegetables were probably preserved. Meat and vegetable soup was commonly used, 12 children having it each day. Fish and chicken, however, were cooked and served alone, often at the same meal with pork. Eleven of the children had approximately 200 grams, or almost half a pound of meat, fish, or chicken each day.

Further protein was supplied by eggs and milk. Sixteen children had eggs in some form, 10 having had the equivalent of one or more per day. Milk appeared in all diets. Three children had approximately a pint, while 14 had less than half a pint each day. This milk was used in cocoa,

TABLE 3

Grams of food per twenty-four hours calculated on the basis of fresh and dried weight

CHILD	AGE	WEIGHT	TOTAL WEIGHT OF FOOD		WEIGHT PER KILOGRAM		PERCENTAGE OF WATER IN DIETS
			Fresh	Dried	Fresh	Dried	
Boys							
	years	*kgm.*	*grams*	*grams*	*grams*	*grams*	
E. C	5	13.2	1,008	207	76.4	15.7	79.5
E. E.	5	15.9	1,074	219	67.5	13.8	79.6
H. I.	5	16.3	1,232	285	75.6	17.5	76.9
He. I.	7	18.2	1,305	320	71.7	17.6	75.5
W. F.	8	18.5	1,427	385	77.1	20.8	73.0
G. E.	9	19.4	1,049	287	54.1	14.8	72.7
Sh. C.	9	20.7	1,303	293	62.9	14.2	77.5
S. D.	9	23.1	1,848	523	80.0	22.6	71.8
V. F.	10	26.7	1,734	473	64.9	17.7	72.7
H. T.	10	28.6	1,474	426	51.5	14.9	71.1
F. E.	11	26.5	1,258	370	47.5	13.9	70.6
St. C.	11	29.5	1,160	330	39.3	11.2	71.5
Average			1,323	343	64.0	16.2	74.4
Girls							
M. Y.	5	16.2	1,434	240	88.5	14.8	83.3
P. A.	6	15.0	1,094	209	72.9	13.9	80.9
H. A.	7	16.6	1,098	238	66.1	14.4	78.3
J. E.	7	18.1	1,002	268	55.4	15.8	73.3
G. M.	9	20.8	1,273	368	61.2	17.7	71.1
L. L.	9	23.2	1,788	322	77.1	13.9	82.0
L. F.	12	34.4	1,948	533	56.6	15.5	72.6
T. C.	13	27.6	1,630	380	59.1	13.8	76.7
J. T.	14	34.6	1,470	438	42.5	12.7	70.2
M.*	17	47.0	1,657	483	35.3	10.3	70.8
Average			1,415	333	64.4	14.7	76.5

* Omitted from average.

on cereals, or as milk to drink, almost none being used in cooking. Butter was little used, the average amount per child per day being 8 grams. It was practically never used in cooking. Sugar was used in small quantities also. The children were never served sweet desserts,

custards, pie, pudding, or ice cream, although they sometimes had cookies or cake. Contrary to expectation, only 4 of the children had tea, and this was in but small amounts and very weak.

It is seen in the foregoing discussion that many of the characteristics of diets used in China have been retained in these American homes. The chief modifications are the inclusion of some milk and the substitution of bread for a portion of their rice. Vegetables were probably used less, and meat perhaps more than in the reported diets of the middle classes in China.

Weight of food consumed

The total weight of fresh food consumed daily by each child and the weight after it was dried, are shown in table 3. The average for each child was computed on the basis of his body weight. The bulk of fresh food eaten daily varied from 1002 to 1948 grams. It was noted that all the children in the same family usually consumed about the same weight of fresh food, regardless of the age of the child. The younger children seemed to prefer more liquid food, such as soup, as shown by the percentage of water in the diets. According to the age of the subjects, there were more individual fluctuations in the weight of the fresh food consumed, and in the liquid portions of it, than in the dried portions. It is interesting to note that the values for both fresh and dried food are greatest for those children whose physical condition and environment were the best.

Caloric intake

Table 4 records the energy intake of each child in terms of total calories per 24 hours; and calories per kilogram, per centimeter, and per square meter. It is seen that the values for total calories agreed closely for the two days for 10 of the children, but that they varied considerably for the others. These variations may be attributed to the facts that either more fat was used in cooking on the second day, or that less food was cooked on the first day, since it was Sunday. In general, the average caloric intakes increased with the ages of the children, although there were some marked variations from this trend. The lowest value was 967 for a 5 year old boy, and the highest, 2342 for a 14 year old girl. These variations were somewhat in accord with the physical condition of the children and the economic status of the families. The caloric intakes of the 3 undernourished boys in the C. family were much less than those of other children of the same age, or even younger. The tallest girl, L. F. and the heaviest girl, J. T., as well as the best nourished boys V. F., S. D. and H. T. had the largest intakes.

As shown in chart 1 the total caloric values of the food consumed by the children of this study, especially the girls, are with few exceptions,

TABLE 4

Caloric intake per twenty-four hours

CHILD	HEIGHT	SURFACE AREA	OBSERVED CALORIC INTAKE						EXCESS OF CALORIC INTAKE OVER BASAL HEAT PRODUCTION		PERCENTAGE OF TOTAL CALORIES FROM CEREAL SOURCES
			Period I	Period II	Daily average	Average per kilogram	Average per square meter	Average per centimeter	Total	Percentage	
Boys											
	cm.	*sq. m.*									
E. C.	94.6	0.59	700	1,233	967	73.3	1,636	10.2	123	14.6	21.2
E. E.	99.7	0.67	853	1,599	1,226	77.2	1,830	12.3			20.0
H. I.	106.7	0.72	1,171	1,937	1,554	95.3	2,161	14.5	708	83.7	22.2
He. I.	111.8	0.77	1,527	2,048	1,788	98.2	2,310	15.0	875	95.8	19.9
W. F.	115.6	0.78	1,691	1,801	1,746	94.4	2,233	15.1	718	69.8	59.7
G. E.	117.6	0.81	1,364	1,812	1,588	81.9	1,965	13.5	567	55.5	30.4
Sh. C.	118.1	0.84	1,391	1,364	1,378	66.6	1,635	11.7	381	38.2	39.4
S. D.	127.0	0.91	2,210	2,450	2,330	100.9	2,569	18.3	1,295	125.1	55.6
V. F.	137.5	1.04	2,046	2,214	2,130	79.8	2,052	15.5	850	66.4	50.4
H. T.	128.3	1.07	2,011	2,388	2,200	76.9	2,048	17.2	980	80.3	37.4
F. E.	129.5	1.01	1,756	2,127	1,942	73.3	1,919	15.0	793	69.0	34.9
St. C.	137.2	1.10	1,398	1,648	1,523	51.6	1,388	11.1	323	26.9	52.3
Average			1,509	1,885	1,698	80.8	1,979	14.5	692	65.9	37.0
Girls											
M. Y.	102.2	0.69	880	1,424	1,152	71.1	1,670	11.3	232	25.2	39.7
P. A.	97.8	0.65	951	1,133	1,042	69.5	1,596	10.7	224	27.4	42.6
H. A.	103.5	0.70	1,085	1,149	1,117	67.3	1,591	10.8	165	17.3	49.2
J. E.	108.6	0.75		1,462	1,462	80.8	1,962	13.5	453	44.9	22.0
G. M.	121.9	0.84	1,606	1,667	1,637	78.7	1,949	13.4	633	63.0	56.4
E. L.	125.1	0.90	1,331	1,837	1,584	68.3	1,754	12.7	528	50.0	45.8
L. F.	146.7	1.17	2,200	2,484	2,342	68.1	1,997	16.0	1,058	82.4	58.3
T. C.	132.7	1.01	1,538	2,052	1,795	65.0	1,770	13.5	781	77.0	36.5
J. T.	136.5	1.18	1,492	2,911	2,202	63.6	1,869	16.1	1,040	89.5	36.5
M.*	145.4	1.45	2,227	2,173	2,200	46.8	1,521	15.1	1,006	85.4	54.4
Average			1,385	1,791	1,593	70.3	1,795	13.1	568	53.0	43.0

* Omitted from average.

less than the values reported by Holt (19) and Hawley (18) for American children of the same age, in some cases as much as 40 per cent less. This is not surprising since these Chinese children were generally smaller than

American children of the same age. On the whole, it was noted that those children whose caloric intakes were farthest below the standard values were those who lived in the Chinese district and who appeared to be either undernourished or stunted in growth.

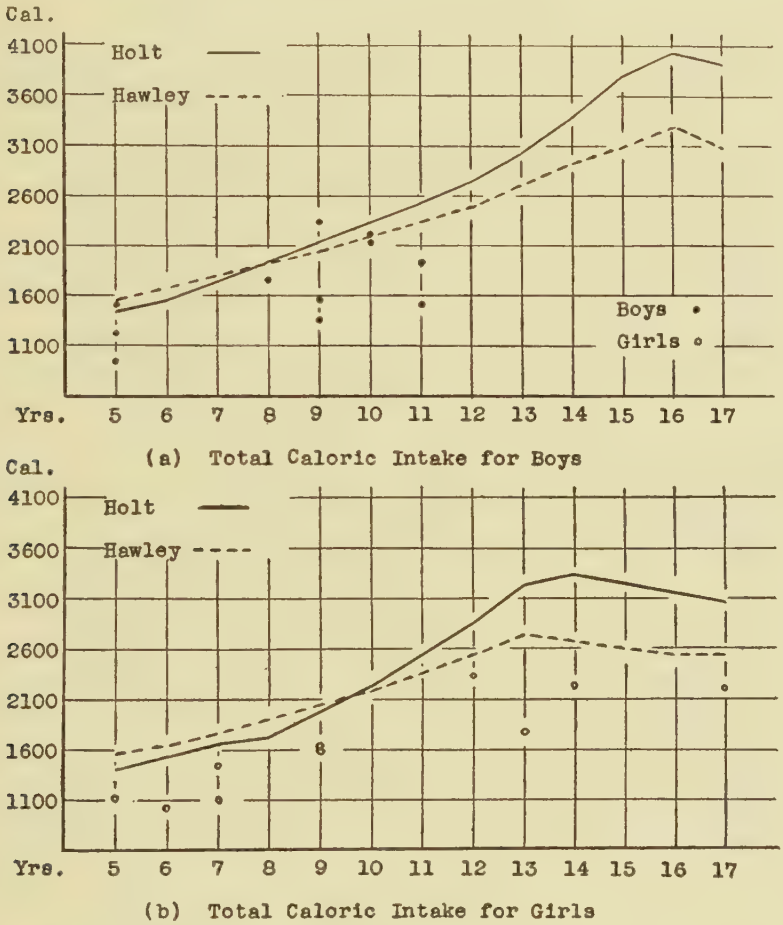

Chart 1. Total Caloric Intakes of Children Compared with Standards

On the per kilogram basis, the caloric intakes decreased with the ages of the subjects. These values, moreover, are nearer to the American standards than those for total calories, the average value for the group being slightly above the standard, and figures for few children varying from it more than 20 per cent (chart 2).

The caloric intakes per square meter varied widely with the ages.

This variation does not support Rübner's (28) claim that the caloric intake calculated on the basis of body surface remains comparatively constant, irrespective of age.

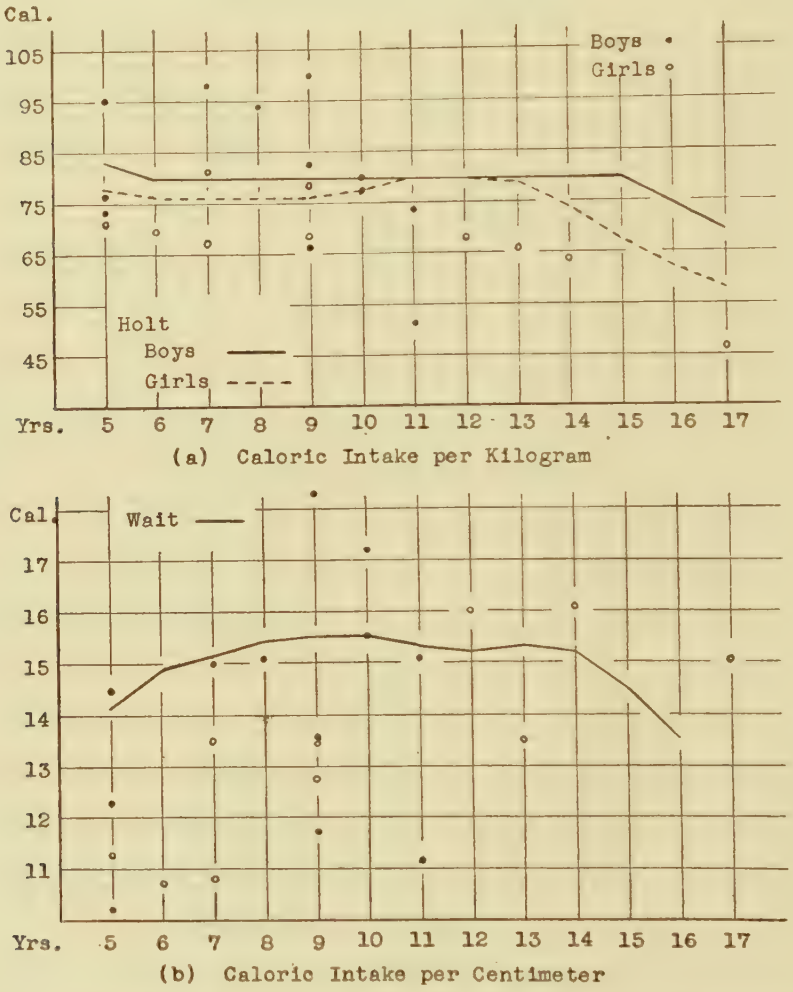

Chart 2. Caloric Intakes of Children per Kilogram and per Centimeter Compared with Standards

When calculated per centimeter of height, the caloric intakes do not show the constancy for all ages which was noted by Wait (39), but range from 10.2 to 18.3. Not only is the variation greater, but the averages are from 10 to 15 per cent lower than Wait's figures (chart 2).

The caloric value of the food consumed by the observed children in excess of their basal heat production, obtained by metabolic determinations, varied from 123 to 1295 or from 14.6 to 125.1 per cent above their basal needs (table 4). According to the assumption of Lusk (22), the approximate total energy requirement of a normal, active child is twice as much as his basal needs. On this basis, the boys S. D., and He. I. were the only children studied who received sufficient calories in their food to supply basal, growth, and activity demands. Lusk also concluded that a quiet child might obtain enough nourishment if his excess calories were only 50 per cent more than his basal needs. The caloric value of the food consumed by 7 children of this study was less than 50 per cent in excess of their basal requirements.

According to the Baldwin-Wood (10) height-weight-age table, children between the ages of 5 and 14 ought to gain from 2 to 5 kgm. each year, and according to Rübner (29), a child should consume 80 calories of food per day in excess of his basal needs, in order to gain 1 kgm. per year. If these conclusions be correct, the observed children needed from 160 to 400 calories of food per day for growth alone. Six of the 7 children previously mentioned received less than 400 calories above their basal requirements. The undernourished boys in the C. family were included in this group of 7 children, and it is probable that they were not receiving sufficient food for all their bodily needs.

The dietary studies reported from China indicate that from 70 to 90 per cent of the caloric value of the diets of the common people are composed of cereals or their products. Sherman (30) estimates that American children derive about 38 per cent of their total calories from cereal sources. The average cereal consumption of the Chinese children of this study was approximately 40 per cent of their total calories (table 4). The individual percentages, however, ranged from 20 to 60. Seven children had over 50 per cent and 5 less than 30 per cent.

Protein intake

Table 5 shows the protein consumed by each child. Although there was a slight tendency for the total protein consumption to increase with the ages of the subjects, there were wide variations in the daily intakes of children of the same age. The amounts varied from 28.0 to 106.3 grams per day. The intakes of 3 boys exceeded the values used for comparison (chart 3), while the intakes of 10 children, possibly on account of their small size, were more than 20 per cent below the standard.

The protein intakes per kilogram of body weight ranged from 1.89 to

3.80 grams, with an average of 2.99 grams for the boys and 2.55 for the girls. The majority of these values were near Holt's figures (chart 3). All but 2 of the children, moreover, had 2 or more grams of protein, 8

TABLE 5

Protein intake per twenty-four hours

CHILD	OBSERVED PROTEIN INTAKE				PERCENTAGE OF TOTAL CALORIES DERIVED FROM PROTEIN SOURCES	PERCENTAGE OF TOTAL PROTEIN DERIVED FROM ANIMAL SOURCES
	Period I	Period II	Daily average	Average per kilogram		
			Boys			
	grams	*grams*	*grams*	*grams*		
E. C.	28.0	50.4	39.2	2.97	16.2	74.2
E. E.	37.8	59.5	48.7	3.06	15.9	71.5
H. I.	30.7	63.7	47.2	2.89	12.1	70.3
He. I.	49.7	67.0	58.4	3.21	13.1	76.5
W. F.	64.8	59.3	62.1	3.36	14.2	50.2
G. E.	57.7	65.1	61.4	3.16	15.5	34.5
Sh. C.	43.7	57.0	50.4	2.43	14.6	33.9
S. D.	96.7	78.7	87.7	3.80	15.1	50.6
V. F.	89.2	79.9	84.6	3.13	15.9	57.2
H. T.	83.5	86.6	85.1	2.98	15.5	69.8
F. E.	64.6	84.7	74.7	2.82	15.4	70.6
St. C.	39.9	71.4	55.7	1.89	15.0	65.4
Average	57.2	68.6	62.9	2.99	14.9	60.4
			Girls			
M. Y.	33.1	49.7	41.4	2.56	14.4	47.8
P. A.	31.5	39.5	35.5	2.37	13.6	64.2
H. A.	30.5	40.1	35.3	2.13	12.6	50.7
J. E.		56.9	56.9	3.14	15.6	75.0
G. M.	73.8	52.7	63.3	3.04	15.5	52.3
E. L.	49.2	59.7	54.5	2.35	13.8	42.4
L. F.	97.2	79.1	88.2	2.56	15.1	50.8
T. C.	48.2	90.1	69.1	2.50	15.4	73.3
J. T.	53.5	106.3	79.9	2.31	14.5	46.1
M.*	102.2	77.9	90.1	1.92	16.4	46.7
Average	49.0	63.8	58.2	2.55	14.5	55.8

* Omitted from average.

having as much as 3 grams, the allowance which some authorities deem adequate for growth. It is true that Parsons (27) established nitrogen equilibrium in healthy children on 1.1 grams per kilogram; but Wang, Hawks and Kaucher (41) showed that better growth resulted on 4.0

than on 2.0 grams of protein. Therefore, the Chinese children of this study were receiving more than the minimum, if not the optimum, amount of protein recommended by those authors.

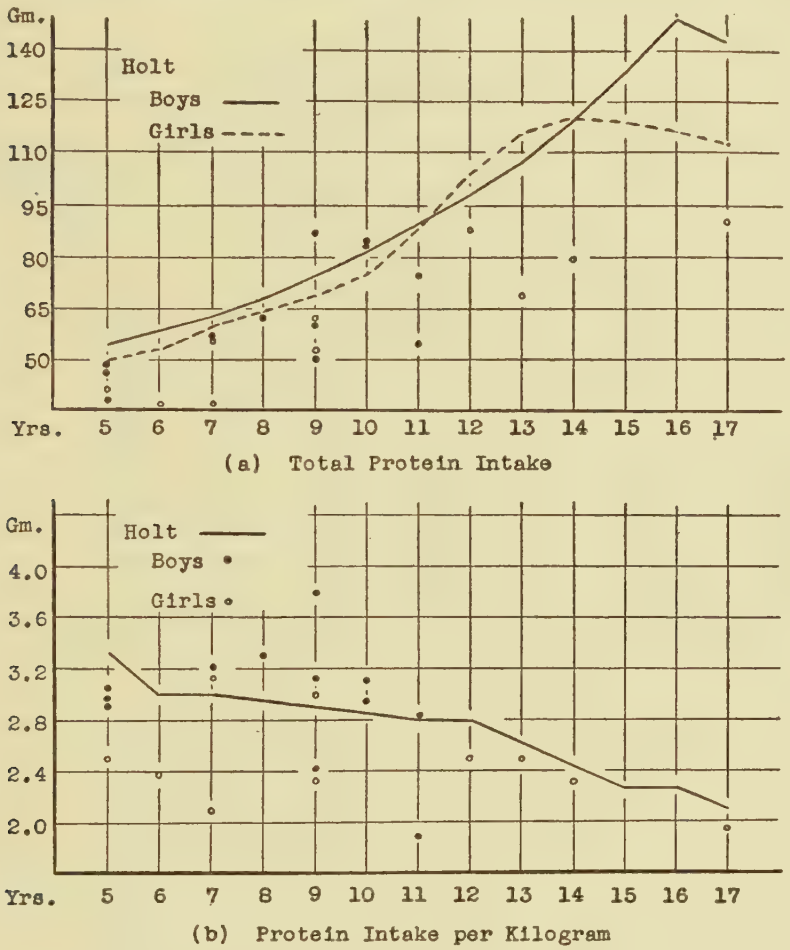

Chart 3. Protein Intakes of Children Compared with Standards

It is significant that the children with the lowest protein intakes also had the lowest caloric intakes. The protein in the observed diets comprised from 12.1 to 16.4 per cent of the total caloric intakes. This proportion corresponds closely to the 10 to 15 per cent recommended by Sherman (30). Since the caloric intakes of some of the children were probably insufficient, a part of the protein may have been used for energy.

Table 5 shows that the proportion of total protein derived from animal sources ranged from 33.9 to 76.5 per cent, the averages being 60.4 and 55.8 for the boys and girls respectively. Although these averages are

TABLE 6

Calcium intake per twenty-four hours

CHILD	OBSERVED CALCIUM INTAKE				PERCENTAGE OF TOTAL CALCIUM DERIVED FROM MILK
	Period I	Period II	Daily average	Average per kilogram	
	Boys				
	grams	*grams*	*grams*	*grams*	
E. C.	0.370	0.581	0.475	0.035	46.3
E. E.	0.805	0.709	0.758	0.047	46.8
H. I.	0.556	0.928	0.742	0.045	59.1
He. I.	1.014	0.998	1.006	0.055	68.7
W. F.	0.230	0.424	0.327	0.018	31.5
G. E.	0.400	0.932	0.666	0.034	37.4
Sh. C.	0.528	0.499	0.514	0.024	40.1
S. D.	0.492	0.675	0.583	0.025	46.8
V. F.	0.454	0.663	0.559	0.021	46.5
H. T.	0.383	1.240	0.811	0.029	27.1
F. E.	0.364	1.084	0.724	0.027	25.7
St. C.	0.369	0.642	0.506	0.017	47.2
Average	0.497	0.781	0.639	0.031	43.6
	Girls				
M. Y.	0.398	0.887	0.642	0.040	60.3
P. A.	0.874	0.912	0.893	0.059	87.8
H. A.	0.724	0.871	0.797	0.047	64.0
J. E.		0.807	0.807	0.044	12.5
G. M.	0.396	0.399	0.397	0.019	45.3
E. L.	0.506	0.982	0.745	0.032	57.4
L. F.	0.333	0.780	0.556	0.017	45.1
T. C.	0.721	1.288	1.004	0.036	46.7
J. T.	0.239	1.447	0.842	0.024	13.9
M.*	0.508	0.511	0.510	0.011	40.2
Average	0.508	0.911	0.743	0.035	48.1

* Omitted from average.

between Holt's (19) maximum and minimum recommendations of 66 and 50 per cent, 6 children had less than the minimum and 7 more than the maximum. It may be noted that even the children who were receiving

the smallest proportion of animal protein had nearly three times as much as that reported in a typical Chinese diet among the poorer classes, which was only from 5 to 10 per cent of the total protein intake.

TABLE 7

Phosphorus intake per twenty-four hours

CHILD	OBSERVED PHOSPHORUS INTAKE				RATIO P/Ca
	Period I	Period II	Daily average	Average per kilogram	
			Boys		
	grams	*grams*	*grams*	*grams*	
E. C.	0.484	0.838	0.661	0.050	1:1.39
E. E.	0.768	0.932	0.850	0.054	1:1.12
H. I.	0.658	1.227	0.942	0.058	1:1.27
He. I.	1.061	1.260	1.161	0.064	1:1.15
W. F.	0.765	0.784	0.774	0.042	1:2.37
G. E.	0.737	1.073	0.905	0.047	1:1.36
Sh. C.	0.722	0.891	0.807	0.039	1:1.57
S. D.	1.244	1.086	1.165	0.050	1:2.00
V. F.	1.153	1.087	1.120	0.042	1:2.00
H. T.	0.957	1.512	1.239	0.043	1:1.53
F. E.	0.835	1.286	1.060	0.040	1:1.46
St. C.	0.570	1.085	0.828	0.028	1:1.64
Average	0.830	1.088	0.959	0.046	1:1.57
			Girls		
M. Y.	0.524	0.935	0.730	0.045	1:1.14
P. A.	0.765	0.871	0.818	0.055	1:0.92
H. A.	0.654	0.881	0.767	0.046	1:0.96
J. E.		0.934	0.934	0.052	1:1.16
G. M.	0.964	0.708	0.836	0.040	1:2.11
E. L.	0.713	1.067	0.890	0.038	1:1.19
L. F.	1.138	1.199	1.168	0.034	1:2.10
T. C.	0.867	1.444	1.156	0.038	1:1.15
J. T.	0.767	1.768	1.267	0.037	1:1.50
M.*	1.285	0.947	1.116	0.024	1:2.19
Average	0.799	0.979	0.952	0.043	1:1.36

* Omitted from average.

Calcium and phosphorus intakes

The calcium intakes of these 22 children ranged from 0.230 to 1.447 grams, with averages of 0.639 and 0.743 gram for the boys and girls respectively (table 6). Only 2 children had an average intake of 1.0

gram, the allowance proposed by Sherman and Hawley (31), although the intakes of 4 others closely approached that amount. The majority of the values were between 0.5 and 0.8 of a gram. Nine children had less than 0.6 of a gram, the amount which produced a negative balance in the children on the low calcium diet reported by Courtney and Brown (14). With one exception, every child in the study had a higher calcium intake than the 0.337 gram which Wu and Wu (41) estimated as the average daily calcium intake in diets used in China.

Based on kilograms of body weight, the average calcium intake of the group was approximately equal to Sherman's estimated requirement. The intakes of 8 children fell below his standard from 10 to 54 per cent, while the intakes of 6 exceeded it by 20 or more per cent. The values for 6 children were lower even than the minimum requirement of 0.023 gram established by Wang and her associates (42). The low calcium content of some of the diets was undoubtedly due to the fact that they contained so little milk.

The average daily phosphorus intake of each child, as tabulated in table 7, ranged from 0.661 to 1.267, no individual intake being so much as 1.32 grams, the requirement given by Sherman (30). The average amount observed was a little lower than the average of 1.178 grams calculated by Wu and Wu (49) from the Chinese diets. Although, when expressed per kilogram, the phosphorus intakes ranged from 0.028 to 0.064 gram, they did not show such wide variations from Sherman's standard as did the calcium intakes, half of the children having had more than his requirement. With two exceptions, all of the intakes exceeded the minimum requirement of 0.034 gram given by Wang, Kern and Kaucher (42).

The average of the calcium to phoshorus ratios as shown in table 7 is 1:1.4. This is practically the same as the ratios calculated from the values for calcium and phosphorus as given by Sherman and also by Wang and her associates, and above the ratio calculated from the calcium and phosphorus in the normal diet given by Orr and his co-workers (26), but lower than 1:3.5, the ratio given by Wu and Wu.

SUMMARY

An individual dietary study was conducted in the homes of 22 Chinese American children living in Chicago. All food was analyzed for calories, protein, calcium and phosphorus.

1. Chinese methods of preparing and cooking food were used in most cases, although there was evidence of the effect of American customs.

The average daily consumption of rice was 276 grams; other cereals, 93.5 grams; vegetables, 133 grams; fruit, 121 grams; milk, 268 grams; butter, 8 grams; meat, 152 grams; eggs, 35 grams.

2. The daily total caloric value of the food consumed varied from 967 to 2342, the average amounts being from 12 to 28 per cent below the values given by various authors for children of the same age. On the per kilogram basis, the calories approximated the accepted American standards. Seven of the children had caloric intakes less than 50 per cent above their basal requirements. About 40 per cent of the total calories were derived from cereal sources.

3. The total protein in the diets varied from 35.3 to 90.1 grams, while the values per kilogram varied from 1.89 to 3.80 grams. From 33.9 to 76.5 per cent of this protein was derived from animal sources, the average amount being about 58 per cent.

4. The total calcium intakes varied from 0.327 to 1.006 grams, and the values per kilogram varied from 0.011 to 0.059 gram.

5. The total phosphorus intakes ranged from 0.661 to 1.267 grams, and on the per kilogram basis from 0.024 to 0.064 gram.

6. The calcium to phosphorus ratios averaged 1:1.4.

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A STUDY OF CHINESE AMERICAN CHILDREN

II. Physical Measurements*

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It has long been recognized that Oriental peoples are smaller in stature than Occidental peoples. It was therefore interesting to compare the height, weight and surface area of the 22 Chinese American children whose dietary habits have previously been discussed (14) and whose basal metabolism will be reported in a later communication (15), with anthropometric measurements made on Chinese children, and also with the Baldwin-Wood (6) standards for American children.

LITERATURE

Early in the twentieth century, the medical missionaries Crook (12), Merrins (20), and Pyle (21), and an anonymous writer (1) independently measured children in South and Central China. In 1915, the China Medical Missionary Association appointed a committee to investigate the height and weight of Chinese children, for the purpose of establishing standards of development. Whyte (32), the chairman of the committee, published in 1918 the collected data from North and South China, on a total of 1684 boys and 438 girls. These early studies were not satisfactory because there were numerous chances for error in the collection of data. In the first place, the Chinese custom of considering a child one year old when he is born and adding the second year to his age on the next lunar New Year, made it necessary to subtract routinely, either one, or one and a half years from the stated age of the child, in order to secure the chronological age. Errors also arose from the facts that inaccurate measuring instruments were used and that the investigators did not observe proper technique.

Two years later, therefore, the research committee was reorganized and the use of calibrated instruments and standardized technique

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recommended by Aleš Hrdlička (16) was advised. Accordingly, two members of the committee, Appleton and Shirokogoroff (2, 3, 22, 23) carried on extensive investigations, working both together and separately. They measured approximately 2000 children throughout large areas of China, and found decided anthropological differences among the many races of which the population of China is composed. This fact was confirmed by Stevenson (26) when he summarized in 1925 the data obtained by different members of the committee in all the provinces of China and in Manchuria. Although measurements for 9630 boys and 1233 girls were recorded, Stevenson considered that the figures from only three provinces were numerous enough to be statistically sound. These data formed the basis for growth standards for children of North, Central, and South China. Li and Chang (19) combined these three tables into one height-weight-age table which is designated as the most acceptable standard for all Chinese children to-day. The values in this table are considered preliminary, however, because the number of children measured, particularly girls, does not adequately represent the vast masses of children throughout the Chinese Empire.

Keys and Cadbury (18) and Hsu and Liang (17) each reported physical measurement studies on superior school boys in South China. The figures for the height and weight of these boys were greater than those reported for other children of the same age. The authors attributed this difference to the fact that the boys' fathers were wealthy merchants who were able to provide adequate diet and wholesome environment. The measurements and ages of the boys in the latter study had been taken according to Stevenson's outline of procedure (25, 27).

At a meeting of the National Medical Association of China in 1930, a proposal was made to carry on a nation wide study of height and weight measurements of Chinese school children in order to compile more accurate tables by which the nutritional status of children could be determined. In response to this proposal, Westbrook and Lai (32) published the measurements of about 2000 college and public school students in Shanghai and Woosung. Undoubtedly investigations will be completed in the near future which will give more accurate records of the size of Chinese children.

Anthropometric studies of Chinese children living in Hawaii were conducted first by Bobbitt (8) and later by Cox (9, 10, 11) and Appleton (4, 5). The results of these studies show that children of the second and third generations of Chinese in Hawaii are larger than those of the same age in China. The authors concluded also that their subjects were

of a more slender build than American children, or in other words, that they were taller for their weight, a body proportion which seemed distinctive of the Oriental race.

Thus it is seen that the tables compiled by Li and Chang are the best standards for Chinese children to-day. Since they were published, however, a large number of children have been, and are being measured, and without doubt there will be more adequate standards in the future, particularly for Chinese girls.

EXPERIMENTAL PROCEDURE

Height and weight measurements of 22 Chinese American children, 12 boys and 10 girls, between the ages of 5 and 17 were made in connection with the basal metabolism tests (15). Early in the morning before food had been taken, each child was weighed and measured without clothing, on a calibrated scale with a measuring stick attached. Standard equipment and procedure were used.

RESULTS AND DISCUSSION

The observed values for height, weight, and height-weight-index were compared with the figures given by Li and Chang (19), by Appleton (4, 5), and by Baldwin and Wood (6). Table 1 shows the height in centimeters compared with these standards. There were noticeable differences in the heights of children of the same age, the taller ones in general having had the most favorable environment. When compared with the figures reported from either China or Hawaii, the values for 7 of the children were more than 7 per cent below, and the value for only one child (V. F.) was more than 7 per cent above the reported values. The average percentage variations from the reported figures were similar, although those for the boys were closer than those for the girls. The heights of 21 of the children were below the Baldwin-Wood standards for medium sized children, 14 being more than 7 per cent below. When the values were compared with the Baldwin-Wood height-weight-age table, however, it was seen that 14 of the Chinese children were taller than American children of the same weight. This fact confirmed the findings of the investigators in Hawaii (4, 5, 9, 10, 11) that Chinese children are taller for their weights than Occidental children.

As a rule, the weights of the children studied varied with their heights, the children who were the tallest being generally the heaviest, although there were greater fluctuations in the values for weight than in those for height (table 2). The weights of 5 children were more than 7 per cent

above, and those of 9 more than 7 per cent below the Chinese standards. The average percentage variations, however, were slight. The subjects

TABLE 1

Height of children in this study compared with standards

CHILD	AGE	OBSERVED HEIGHT	PERCENTAGE VARIATION FROM STANDARDS			
			Li and Chang (1927) (China)	Appleton (1927-28) (Hawaii)	Baldwin and Wood (1925)	
					Average height for age	Height referred to weight and age
Boys						
		cm.				
E. C.	5	94.6	−9.4	−10.1	−12.4	+5.1
E. E.	5	99.7	−4.5	−5.2	−7.7	−2.2
H. I.	5	106.7	−2.2	+1.4	−1.2	+3.6
He. I.	7	111.8	−2.4	−3.4	−8.3	+2.6
W. F.	8	115.6	−3.1	−4.3	−9.0	+5.6
G. E.	9	117.6	−4.9	−6.5	−10.9	+2.2
Sh. C.	9	118.1	−4.5	−6.1	−10.6	+1.2
S. D.	9	127.0	+2.7	+0.9	−3.9	+4.3
V. F.	10	137.5	+8.4	+6.2	+0.2	+6.0
H. T.	10	128.3	+1.1	−0.9	−6.5	−4.3
F. E.	11	129.5	−1.4	−4.1	−9.0	+0.1
St. C.	11	137.2	+4.5	+1.5	−3.5	+1.2
Average			−1.3	−2.5	−6.9	+2.1
Girls						
M. Y.	5	102.2	−5.4		−3.0	−0.8
P. A.	6	97.8	−14.0	−10.9	−14.4	−1.2
H. A.	7	103.5	−11.7	−11.1	−13.3	−1.1
J. E.	7	108.6	−7.4	−6.7	−9.0	−0.1
G. M.	9	121.9	−3.7	−2.1	−7.7	+5.3
E. L.	9	125.1	−1.2	+0.5	−5.3	+1.7
L. F.	12	146.7	+4.4	+3.6	−0.4	+3.8
T. C.	13	132.7	−9.0	−10.3	−12.9	+4.5
J. T.	14	136.5	−7.8	−10.0	−13.3	−2.5
M.*	17	145.4	−5.8	−6.2	−10.6	−3.7
Average			−6.2	−6.0	−8.8	+1.1

* Omitted from average.

weighed slightly less than Chinese children in Hawaii, and much less, 21.6 and 24.3 per cent less for the boys and girls respectively, than medium sized American children of the same age. The weights referred

to height were quite close to the Baldwin-Wood standard, although 9 children were more than 7 per cent below them, and one child, 9.6 per cent above.

TABLE 2

Weight of children in this study compared with standards

CHILD	AGE	OBSERVED WEIGHT	PERCENTAGE VARIATION FROM STANDARDS			
			Li and Chang (1927) (China)	Appleton (1927–28) (Hawaii)	Baldwin and Wood (1925)	
					Average weight for age	Weight referred to height and age
Boys						
		kgm.				
E. C.	5	13.2	−11.4	−21.4	−27.5	−7.8
E. E.	5	15.9	+6.7	−5.4	−12.6	+1.9
H. I.	5	16.3	+9.4	−3.0	−10.4	−5.8
He. I.	7	18.2	−1.1	−11.2	−24.5	−4.2
W. F.	8	18.5	−13.6	−15.1	−29.9	−8.4
G. E.	9	19.4	−12.6	−19.5	−33.3	−8.5
Sh. C.	9	20.7	−6.8	−14.1	−28.9	−3.3
S. D.	9	23.1	+4.1	−4.1	−20.6	−9.4
V. F.	10	26.7	+11.3	+3.5	−17.3	−13.0
H. T.	10	28.6	+19.2	+10.8	−11.5	+9.6
F. E.	11	29.6	±0.0	−6.0	−25.3	−0.4
St. C.	11	29.5	+11.3	+4.6	−16.9	−3.6
Average			+1.4	−6.7	−21.6	−4.4
Girls						
M. Y.	5	16.2	+15.7		−8.0	+1.3
P. A.	6	15.0	−18.9	−13.3	−26.8	+2.0
H. A.	7	16.6	−17.4	−19.4	−26.8	+1.8
J. E.	7	18.1	−10.0	−12.1	−20.2	+0.6
G. M.	9	20.8	−11.1	−11.5	−28.5	−8.4
E. L.	9	23.2	−0.9	−1.3	−20.3	−4.1
L. F.	12	34.4	+5.5	+3.6	−15.1	−9.4
T. C.	13	27.6	−25.4	−26.2	−39.9	−7.1
J. T.	14	34.6	−12.0	−17.4	−33.2	−7.0
M.*	17	47.0	−1.1	+2.3	−14.5	+4.2
Average			−8.3	−12.2	−24.3	−1.8

* Omitted from average.

The weight-height-index, the weight in kilograms for each centimeter of height multiplied by 100, is sometimes considered an index of the state of nutrition of a child. This index is characteristically low for

Oriental children, and therefore the comparison of the indices of the children of this study with those reported by other investigators (table 3) might indicate whether or not the body proportions of these Chinese

TABLE 3

Weight-height-indices of children in this study compared with standards

CHILD	AGE	OBSERVED WEIGHT-HEIGHT-INDICES	PERCENTAGE VARIATION FROM STANDARDS		
			Li and Chang (1927) (China)	Appleton (1927–28) (Hawaii)	Baldwin and Wood (1925) (America)
Boys					
E. C.	5	14.0	−2.2	−12.6	−17.2
E. E.	5	16.0	+11.8	±0.0	−5.3
H. I.	5	15.3	+7.1	−4.3	−9.5
He. I.	7	16.3	−1.4	−7.1	−17.7
W. F.	8	16.0	−16.4	−11.1	−23.1
G. E.	9	16.5	−8.1	−13.6	−25.0
Sh. C.	9	17.5	−2.3	−8.4	−20.5
S. D.	9	18.2	+1.3	−4.7	−17.3
V. F.	10	19.4	+8.0	−2.5	−17.4
H. T.	10	22.3	+17.9	+12.1	−5.1
F. E.	11	20.5	+1.4	−1.4	−18.0
St. C.	11	21.5	+6.5	+3.3	−14.0
Average			+2.0	−4.2	−15.8
Girls					
M. Y.	5	15.9	+22.3		−4.8
P. A.	6	15.3	−5.8	−2.5	−14.5
H. A.	7	16.0	−6.5	−9.6	−15.8
J. E.	7	16.7	−2.8	−5.6	−12.1
G. M.	9	17.1	−7.7	−9.5	−22.3
E. L.	9	18.6	+0.4	−1.6	−15.4
L. F.	12	23.5	+1.1	+0.9	−14.5
T. C.	13	20.8	−18.0	−17.5	−30.9
J. T.	14	25.4	−4.5	−8.3	−22.8
M.*	17	33.2	+5.0	+8.3	−4.4
Average			−2.4	−6.7	−17.0

* Omitted from average.

children were being influenced by American environment. The observed indices were similar to those of Chinese children in China, 7 being within 8 per cent of the standards. They were slightly lower than those of Chinese children of the second and third generation in Hawaii, and

considerably lower than those of American children of the same age, the values for 17 children being more than 10 per cent below the Baldwin-Wood standards.

TABLE 4

Surface area of children in this study calculated according to various formulas

CHILD	BENEDICT-TALBOT MODIFICATION OF LISSAUER'S FORMULA†	DUBOIS' FORMULA‡	TAKAHIRA'S FORMULA§	TAKEYA'S FORMULA‖
		Boys		
	sq.m.	*sq.m.*	*sq.m.*	*sq.m.*
E. C.	0.59	0.58	0.59	0.61
E. E.	0.67	0.66	0.66	0.68
H. I.	0.72	0.70	0.70	0.73
He. I.	0.77	0.75	0.76	0.78
W. F.	0.78	0.78	0.78	0.81
G. E.	0.81	0.80	0.81	0.84
Sh. C.	0.84	0.83	0.84	0.87
S. D.	0.91	0.92	0.92	0.96
V. F.	1.04	1.03	1.04	1.08
H. T.	1.07	1.01	1.02	1.05
F. E.	1.01	0.98	0.99	1.03
St. C.	1.10	1.07	1.08	1.12
		Girls		
M. Y.	0.69	0.67	0.68	0.70
P. A.	0.65	0.63	0.64	0.66
H. A.	0.70	0.69	0.69	0.72
J. E.	0.75	0.74	0.74	0.77
G. M.	0.84	0.85	0.86	0.89
E. L.	0.90	0.91	0.91	0.95
L. F.	1.17	1.20	1.21	1.26
T. C.	1.01	1.02	1.03	1.06
J. T.	1.18	1.14	1.15	1.20
M.	1.45	1.36	1.38	1.43

† $K \sqrt[3]{W^2}$.
‡ $A = W^{0.425} \times H^{0.725} \times 71.84$.
§ $A = W^{0.427} \times H^{0.718} \times 74.49$ or $A = W^{0.425} \times H^{0.725} \times 72.6$.
‖ $A = W^{0.425} \times H^{0.725} \times 75.05$.

These observations show that the weight-height-indices of the children of this study varied little from those of children of the same age in China; apparently change of environment had not perceptibly influenced the bodily proportions of these Chinese children of the first generation in America.

On account of differences in the height and weight of Orientals and Occidentals, there has been discussion in the literature as to the accuracy of the formulas used for calculating the surface area of Occidentals when these formulas were applied to Orientals. Takahira (29) and Takeya (30) measured Japanese men, and from their results considered it necessary to increase the constant of the Du Bois (13) height-weight formula. Stevenson (24, 28) found by the measurement of Chinese men that the linear formula, with slightly changed factors, gave values nearer to the actual surface area than did the height-weight formula. Waddell, Han and Chin (31), however, found a close agreement between values obtained by the use of the two formulas.

The values for the surface areas of the children of this study, computed by four formulas, are recorded in table 4. The four values for the same child were similar, varying only from 3 to 8 per cent from each other. On the whole, the lowest values were found by the use of Du Bois' height-weight formula, and the highest by Takeya's modification. Since the Benedict-Talbot (7) modification of the Lissauer formula, adapted to the Du Bois linear formula, is often used for the calculation of the surface areas of children, the values obtained by its use were used in the studies on the diets and basal metabolism of the subjects of this investigation.

SUMMARY

The height and weight of 22 Chinese American children living in Chicago were obtained in connection with the basal metabolism tests, and the values were compared with American and Chinese standards.

1. The subjects were similar in height and weight to Chinese children measured in China. The observed values were slightly below those of Chinese children of the second and third generation in Hawaii, and appreciably below the Baldwin-Wood standards for medium sized American children. The average deviations from the standards for both height and weight were greater for the girls than for the boys.

2. These children were taller for their weight than American children, thereby showing their racial characteristics.

3. In general, the children who apparently had the best environment were the largest.

4. The surface areas of the children were calculated according to various formulas for Orientals and Occidentals. The results obtained were similar for the same child.

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